SCIENCE.

FRIDAY, JULY 23, 1886.

COMMENT AND CRITICISM.

BY THE LAST STEAMER from Honolulu we received a letter from our correspondent giving an account of the present condition of the islands (p. 73). The great volcano Kilauea has just passed through a period of inaction. For seven years lakes of fire had been constantly visible. On the 6th of March last the amount of liquid lava flowing in various directions from the familiar lakes or craters called Halemaumau, New Lake, and the Little Beggar, was uncommonly abundant. The following day and night sharp earthquake shocks disturbed the residents at the Volcano house; and immediately afterwards the liquid entirely disappeared, leaving an irregular cavity 3,360 feet in length, and wide enough to embrace the areas of the three great openings. The greatest depth of the liquid removed was 580 feet. Quietness and darkness reigned till the 4th of June, when a new opening showed molten lava about forty feet in diameter. Three weeks later, June 25, the fire came back in earnest, filling up the old Halemaumau and some other portions of the caldera. For a long time to come, therefore, visitors may expect the old-time grand volcanic displays.

THE AMERICAN LIBRARY ASSOCIATION was organized in 1876 at Philadelphia, and the movement was followed at once in England by the founding of the Library association of the United Kingdom in the following year. Subsequent meetings of our own association have been held in New York, Boston, Washington, Cincinnati, and Buffalo, and the annual meeting of a year ago at Lake George. During all this period, Mr. Justin Winsor of the Harvard college library has been the president of the association. A great variety of circumstances has contributed to the interest and importance of the general meeting which was held in July at Milwaukee, under the presidency of Dr. W. F. Poole. To found libraries is the fashion to-day; and the librarians of our country have wisely organized to secure the best results from such splendid bequests as those of Pratt and of Peabody to the city of Baltimore, of the Seymour fund to Auburn, of the Forbes bequest to Northampton, and of the Newberry legacy to Chicago. Efficient management of such funds cannot fail to inspire a like generosity elsewhere. Also the movement toward a correlation of the public library and the public school is one whose success thus far appears to justify the confident expectation of future results of the highest moment.

The continued success of *The library journal*, the inception of a new periodical entitled *Library notes*, and the assured inauguration of the Columbia college school of library economy under the direction of Professor Dewey in January next, are among the noteworthy progressive features of library interests. We find the librarians insuring the success of their ventures in bibliography and indexing, through the co-operative method, now so thoroughly successful as a principle in matters commercial. The reforms of the last few years in library management are most encouraging, and the librarians are now suggesting the propriety of dignifying their work with the title 'learned profession.' We find them venturing, a little early, perhaps, the expression 'library science:' in short, their position has become largely aggressive. While, however, there is much in the new movement that is the subject of adverse criticism, no disinterested person can overlook the vast deal of good that has already been secured. There is, withal, need of continual care, lest, in the drudgery of endless details, the meaning of the proper integration of all these differentials be lost sight of; and there seems to be ground for the apprehension lest, with the rapidly increasing conveniences for library-work, the too great convenience of mere appliances may hamper individual freedom in the use of libraries. Also there is need of perpetual distinction between the mere reader and the thorough student; and in the equipment and management of a library, only the keenly discriminating intellect detects the proper relationship of the two. It very often happens that much of what the tools of the library will accomplish for the reader, the student whose aim is culture will prefer to do for himself. There is entire safety in predicting the ultimate outcome

of all such issues: while the reader may himself be willing to work as a mere cog in the library wheel, the cultured student prefers to make the library merely an auxiliary in his own development.

NEW ZEALAND AND THE RECENT ERUPTION.

New Zealand forms one link of the great volcanic chain that girdles the Pacific Ocean, from South Shetland and Cape Horn up through the Andes, Mexico, British Columbia, and Alaska, crossing into Asia through the Aleutian Islands, and stretching south through the Kurile Islands, Japan, Ladrone Islands, Philippines, and West Indies, to Mounts Erebus and Terror, in the antarctic zone. The greatest volcanic energy is found where this great girdle crosses the torrid zone, — in the northern Andes, Central America, and Mexico, to the east; and in the Philippines and West Indies, to the west. Here the great stresses and pressures caused by the slow cooling and contraction of the crust of the earth are perhaps increased by others due to the centrifugal force of its rapid rotation on its axis. New Zealand lies a thousand miles south-east of Australia, in latitude 40° south, longitude 175° east, the antipodes of Spain, and comprises two large islands (North Island and South Island), with numberless smaller ones around their shores, — an area, in all, of about 100,000 square miles, or nearly that of Great Britain and Ireland.

The accompanying physical map of the islands will indicate at a glance the general topographic features. The centre of North Island is occupied by lofty mountains, which send off spurs in various directions to the coast, and are covered with forests from their bases nearly to their summits. The north-western peninsula abounds in fertile and well-watered valleys, and the main body of the island is characterized by gently sloping hilly ranges and low-lying tablelands, varied here and there by volcanic peaks, and covered with a luxuriant growth of timber. In the south centre is a wild highland region, seldom visited by travellers.

South Island is very different. The snowy peaks of the great southern Alps stretch along its western side, from ten to thirteen thousand feet in height, densely wooded to the snow-line. To the west are vast snow-fields and glaciers; and the coast is deeply and sharply indented by bays and fiords, which, with the numerous lakes of glacial origin, remind one strongly of the coast of Norway, although 30° nearer the equator. A low range lies along the centre of the island, with spurs at right angles, and numerous ravines through which the rivers break their way to the south-east. Farther east are terraces and plains.

North Island, the scene of the recent eruption, is somewhat smaller than South Island, and is about the size of Cuba, though stretching north and south, instead of east and west. The lake district, or region in the north-east centre of the island, has been well called the wonderland of the world, and for magnificent scenery and wonderful development of geysers, fumaroles, and hot springs, comes second only to our own Yellowstone park, if indeed it be not its peer. In the volcanic district, stretching from Mount Egmont, the western promontory, north-eastward through the centre of the island to White Island in the Bay of Plenty, there have been hitherto but two active volcanoes, — Tongariro (6,500 feet), a peak 30 miles south of Lake Taupo; and Wakari (860 feet), on White Island. The great snow-capped dome of Ruapehu, just south of Tongariro, and the highest point in the island (9,190 feet); Mount Egmont (8,200 feet), and the great volcanic promontory on which it stands; and hundreds of other extinct craters and vast fields of lava, tufa, and scoriae, — these all bear witness to the energy of volcanic action in comparatively recent time. And yet there has been no serious eruption till now, within the memory of European settlers, and even the Maori traditions give no account of one. Earthquakes, however, are not uncommon, though seldom sufficiently severe to cause great destruction, Cook Strait being regarded as the centre of the region generally disturbed: 342 were recorded from 1869 to 1879, and 28 in 1882, only one of which was at all severe, while ten were described as 'smart,' and the other seventeen only slight tremors. The most severe shock of which there is any record occurred the evening of Jan. 23, 1855, and caused great destruction in Wellington. Many fissures in the earth, landslides, and a great sea-wave were caused, and minor shocks followed it at decreasing intervals for about three months. There are many evidences that a gradual elevation of the whole country is going on; as, for instance, rocks are now visible in Cook Strait where there were none when the country was first discovered. This indicates that earthquakes or other disturbances are likely to occur, and helps us to understand the late eruption.

Lake Taupo, the great lake in the centre of the island, 1,250 feet above sea-level, 30 miles long, and 20 broad, covering an area of 250 square miles, occupies a depression caused by some great eruption, and is surrounded by cliffs of lava a thousand feet in height, with a little extinct crater

PHYSICAL MAP OF NEW ZEALAND.

GEOLOGICAL MAP OF NORTH ISLAND.

on an island in its centre — like Crater Lake, in Oregon, though on a larger scale. Out of it flows the Waikato River, running 200 miles northerly and westerly; and along its banks, some 25 miles from the lake, is one of the two great geyser districts of the island. The other and more extensive district is 40 miles north-north-east of Lake Taupo, and about the same distance from the shores of the Bay of Plenty. Here, among the mountains, lakes, and forests of the famous lake district of New Zealand, are the celebrated geysers, hot springs, mud volcanoes, and solfataras, which rank next to those of the Yellowstone in interest, and even surpass those of Iceland. Of the lakes the most picturesque is Tarawera, surrounded by rugged bluffs, with the mountain-peak of the same name close by, to the eastward. Next in size is Lake Rotorua, 6 miles in diameter, with a little extinct volcanic cone in the centre. Rotomahana, or Warm Lake, is surrounded by boiling springs and siliceous terraces, and the temperature of the whole body of water is always as high as 90° F.

It was here, then, in the lovely lake district, and from the 'not dead but sleeping' peak of Tarawera, that the great eruption burst forth on June 10, — an eruption unprecedented in the history or traditions of the island, though far surpassed by others that have left their ineffaceable record in the rocks. Two years ago, it is said, the water of Lake Ratakakahi, usually cold, grew hot; and there was a strong outflow down the Wairoa valley into Lake Tarawera for a day, when it resumed its normal condition. This was all the warning, so far as yet known, of this awful convulsion. At 1 A. M., the inhabitants of the little village of Wairoa were aroused by a violent shaking of the earth, followed by a continuous but not unpleasant motion. A bright red glow became visible about the top of the mountain, and vivid flashes of light seemed to shoot up into the air. In an hour the flashes of light became what seemed a massive pillar of fire, rising, increasing, and extending along the range. A dull rumbling accompanied it, and became a terrific roar, with continuous explosions, loud thunder, and vivid lightning, till heaven and earth seemed to be torn asunder. The air was filled with sulphurous odors, falling stones, mud, and lava. The village was annihilated, more than a hundred natives perished, and the fertile plains were buried in mud and ashes.

Such, briefly, are the first particulars that have reached us of this terrible convulsion. It has indeed given a temporary check to the progress of the island. But the mountain is now said to be quiet again, and perhaps not many years will have passed before the catastrophe is forgotten and its damages repaired, as has been so often the case with Vesuvius and Etna. Geology teaches that this is an old and dying region of volcanic energy, and that each eruption is less violent than the one preceding. We may therefore hope that this paroxysm will give relief, until the tension of the earth's crust, accumulated for another decade of centuries, shall again burst its bonds.

Everett Hayden.

THE AMERICAN LIBRARY ASSOCIATION.

The ninth general meeting of this association was convened at Milwaukee, Wis., on Wednesday, the 7th of July, and was dissolved on Saturday of the same week. Dr. W. F. Poole, president of the association, and librarian of the Chicago public library, presided at all the sessions, of which the first were mainly devoted to the reports of committees, and the address of the president, which was brief and pertinent. Dr. Poole dwelt on the present urgent needs of libraries in general, and regarded it as a great misfortune that the plans for a building for the library of congress, presented to the association at its Washington meeting in 1881 and condemned by the unanimous voice of its members, and also the year following at Cincinnati, should have been definitely adopted by congress. The committee on the American library association catalogue reported progress in the work of formation of a catalogue of the works most suitable for the foundation of public libraries. The programme of the meeting was one of unusual interest, embracing about twenty-five papers relating in large part to special points in library management, though by no means wholly so. For example: Mr. Richardson's (Library Hartford theological seminary) paper, 'Why librarians know,' showed a very good basis for his modest plea for the recognition of librarianship as one of the learned professions. Whether they profess it or not, at all events librarians practise learning, and they have to do so, or they couldn't be librarians. The librarians of the new era are a long way from exemplifying the common insinuation that their knowledge relates rather to the outside of books than to their contents. Among librarians the number of book-producers is very large. Mr. Charles A. Cutter (Boston athenaeum) followed with a brief paper on 'Close classification,'— a problem which, more perhaps than any other, is agitating the librarians of to-day. Shall the library be divided into a few broad classes, — history, geography, science, art, literature, and the like: or shall these be broken into smaller parts, setting the history of England, Germany, France, etc., each by itself, and breaking up science into physics, botany, zoölogy, etc.;

or shall the subdivision be carried further, making periods in the history of countries, and dividing zoölogy into the orders and families of animals, and so on, or, even further still, allowing a place in the history of England, France, and Germany for every reign, also dividing mathematics into arithmetic, algebra, the calculus, etc., and breaking up orders of animals into genera and species? Each successive subdivision intensifies the difficulty of keeping all the books on a subject together. Grouping books does not remove them one from another at all: they are no farther off than before subdivision. Mr. Cutter was a strong advocate of putting by themselves all books on well-marked subjects. Mr. Lane (Harvard college library) submitted specimen sheets of an index for catalogues, which elicited discussion; following which was a paper on 'Close classification vs. bibliography,' by Mr. William I. Fletcher (Amherst college library). Classification as used in the sciences, he said, may be exact; but as used in a library it cannot be, for the reason that many of the best contributions to the discussion of a subject are not detachable from the books or sets of publications which contain them. The librarian must advise his readers to find in every possible way what is the actual literature of the subject he may have in hand. Bibliography is the watchword for the librarian of the future; and this, rather than classification, must furnish readers with the means of tracing the literature of their subjects. Mr. Fletcher regarded close classification as having fatal defects, as a system for the guidance of the reader to the resources of a library in a given subject; and it should be relegated to a subordinate place as a minor factor in library administration. The library system of our day has one important mission, that of furnishing the means of culture to a people whose life is in danger of being drawn into a fatal specialization. Mr. Fletcher characterized the prevailing system of classification as an attempt to substitute machinery for brains, and said that the greatest present needs of our libraries are intelligent librarians and assistants, and the best obtainable intelligence crystallized in bibliographic books.

Next came an elaborate paper on 'International copyright in congress,' by Mr. T. Solberg (Library of congress), who reviewed at great length the history and progress of congressional legislation on this subject. The paper was not read, but will be printed in full in the Proceedings of the association.

The evening session of the second day was entirely characteristic of the work of the association, being largely occupied with the technical details of library work, and embracing papers and talks by Mr. Cutter on author-notation for Greek and Latin classics, by Mr. J. N. Larned (Buffalo public library) on a few of the devices and arrangements in a library building, and by Mr. Melvil Dewey (Columbia college library) on 'Eclectic book-numbers,' illustrating simple methods of finding books on the shelves. Mr. R. B. Poole (Y. M. C. A. library, New York) reported, for the committee on congressional legislation, a resolution, which was adopted, recommending such legislation as shall enable libraries to send books to their outside clientage as second-class matter at one cent per pound.

The evening session of the third day was taken up with two noteworthy papers, — 'The first librarians' convention, 1853,' by Mr. E. M. Barton (American antiquarian society, Worcester); and 'The teaching of bibliography in colleges,' by Mr. R. C. Davis (Michigan university library), giving an outline of the system now employed at Ann Arbor.

Perhaps the most important matter coming before the meeting of the association was the report made at the morning session of the third day by Mr. Fletcher, on behalf of the committee on co-operative cataloguing, — a scheme which received some notice in *Science* a few weeks ago. The object in view is the preparation and printing of such catalogues, bibliographic guides, and indexes as shall serve to relieve the several libraries of a large share of the expense of the present system of publishing expensive individual catalogues. The committee had received replies from some seventy different libraries, favoring the organization of a publishing section of the association, after the pattern of the early English text and the Shakspeare societies. The association next heard the reading of a paper on 'Library buildings,' prepared by Mr. Eirikr Magnússon (Cambridge, England, university library), advocating the Archimedean spiral as the form most suitable for the library structure of the future. This plan was illustrated in the London *Athenæum* some months ago, and may fairly be conceded to present certain advantages; viz., a maximum of book-space with a minimum of material used in construction, the possibility of enlargement of the original structure perpetually as required, without disturbing in the least the operations of the central library or its functions. But the association, while extending a cordial vote of thanks to Mr. Magnússon for his paper, was entirely unanimous in condemning his proposed library. In particular, Dr. Poole said the idea was substantially an old one, rejected long ago, and that the enforced sky-light for the book-stacks was a very serious disadvantage. Other members criti-

cised the proposed building on the ground of supposed structural weakness, the unavoidable darkness of the stack when its roof might be under deep snows, and the impossibility of thorough ventilation, as no side windows or apertures could be provided.

The subject of the electric lighting and heat-regulation in libraries was next taken up, Dr. Poole relating his experience with both gas and electricity, and characterizing the latter as a luxury which none but the wealthier libraries could afford; while Mr. Dewey pronounced unequivocally in favor of electricity from experience with the Edison incandescent system in the new Columbia college library. Its absence of heat is greatly in its favor in the summer illumination of libraries; it gives off no products of combustion which, like gas, may injure the bindings of the finer volumes; and Mr. Dewey had found many people coming into the library to read by the electric light who were sufferers from eye-troubles if they tried to read by gas, or even petroleum illumination. No member of the association, however, could give precise information of the relative cost of gas and electric light, owing to the running of the dynamos for steam boilers used for other purposes. In recent issues of *Science*, the results of English experiments in this direction placed the electric light at very great disadvantage in point of expense, and made it cost at present about twice as much as gas. Mr. Cutter (Boston athenaeum) and Mr. Linderfelt (Milwaukee public library) explained the action of the apparatus employed in their libraries for the automatic regulation of the heat-supply, and pronounced it thoroughly satisfactory. The system involves the electric control of the registers and the openings in the windows, and is found to be competent to maintain the rooms at any desired temperature for which the indicator is easily set, as well as to effect a considerable saving of fuel. A delegate from Kansas said, that in his region natural gas is used over a large area, furnishing the library with both heat and light.

The other papers presented at the Friday session were by Mr. Woodruff (Cornell university library), on 'The relation of university seminaries to the university library;' and by Mr. Utley of Detroit, on 'The relation of the public library to the public schools,' in which it was stated that the supreme court of Michigan had ruled that the library is a part of the apparatus of the school, and the plan of reading and discussing the books in the schools during recitation hours had given admirable results. A vigorous discussion of the subject of binding books in libraries ensued; and the third day's session closed with the adoption of a resolution commending to states and institutions the trial of a plan for the collection and redistribution of documents, which had succeeded admirably under the direction of the secretary of the interior.

The untransacted business of the meeting necessitated a session on the fourth day (Saturday), when Mr. Green of the committee on public documents presented a report embodying the bill, now in the hands of the senate committee on printing, which will instruct the public printer to deliver to the interior department a sufficient number of copies of every government publication to enable every depositary of public documents to receive one. The measure is ably supported by Senator Hoar, for whom a vote of thanks was passed by the association. Mr. Green's report provoked animated discussion, and was followed by a paper by Mr. J. Schwartz (Apprentices' library, New York), which was mainly a satire on various prevailing systems of classification.

The secretary read a thoughtful paper on bibliography in general, and especially on the bibliography of the literature of science, by Mr. Mann of Washington, who remarked first the rapid rate of increase within the last few years of the application of bibliography to the work of the student of science — who is, nevertheless, apt to set too little value upon the refinements of the art of bibliography. The necessity of providing some method of indexing is the first lesson to be learned in the making of a useful bibliography, and such index should be very detailed. To secure the advantages of a condensed method of reference, some symbolism should be employed. The usual method of making citations in scientific writings is to refer to individual or separate works by the name of author, title, and page; to articles in periodicals by title of periodical, date (sometimes), and page. A very useful device is to give in a preface or appendix a list of all the works cited, with some symbol attached, and to refer to this symbol whenever references are to be made. Some authors have undertaken to accept some bibliography, the catalogue of the Royal society, for instance, as a standard, and to refer to the symbols employed in that; but there are many difficulties in the way of its use as such. Mr. Mann regards the arrangement of titles in a current bibliography as a matter of very little consequence. Nothing should be allowed to interfere with the practice of appending to each title a current numeral, the series of which should be continuous from volume to volume. As an aid to scientific investigation, the works enumerated in a bibliography should be analyzed, this analysis indicating the special phase of the subject treated

in the work. Difficult analyses should be made by specialists. Each title in the bibliography should be confined as closely as possible to a single subject, even to the extent of entering the several chapters of the work as separate titles whenever they treat of distinct subjects. The whole work may be integrated under its own title by giving the list of its chapters in the analysis of the work itself.

Aside from its cost, the principal difficulty in the preparation of a bibliography like that described lies in getting any person or persons to undertake the labor and responsibility of writing or editing the work. The magnitude of the task is apparent. If, however, the work can be issued as a current bibliography, with no regard to the order of titles or the connection of subjects, making use only of such material as may be available at the time, and attaching to each title a current number to serve for reference from an index, no editor need feel oppressed with the magnitude of his task. Whatever is done will be a step in the right direction; and the work may, if need be, temporarily be abandoned, without a loss in value of what has already been accomplished. It is only necessary that the titles of chapters and articles be given accurately, and that the analytical references be made fully; while the rest may be left to others who for their own purposes will make indexes to take the place of any special analyses of contents.

The publishing section was duly organized before final adjournment, and this move on the part of the association is of the first importance. The section will begin at once the publication of indexes to scientific and other essays, and prosecute whatever work may be found practicable in the line of co-operative bibliography.

The association were handsomely received and entertained by the mayor, the Hon. Emil Wallber, and citizens of Milwaukee; and the success of the meeting was largely secured through the exertions of Mr. K. A. Linderfelt of the Milwaukee public library. On Monday, the 12th, the association left Milwaukee for an eight-day excursion in northern Wisconsin.

The officers elected for the ensuing year are, president, Dr. Poole; vice-presidents, Mr. Spofford (Library of congress), Judge Mellen Chamberlain (Boston public library), and Mr. W. E. Foster (Providence public library); secretary, Prof. Melvil Dewey; assistant secretary, Mr. Richardson; treasurer, Mr. Carr of Grand Rapids.

At the conclusion of its last session, the association was adjourned to meet at the Thousand Islands, in the second week of September, 1887.

DAVID P. TODD.

HONOLULU LETTER.

THE Sandwich or Hawaiian Islands, situated about 2,000 miles to the south-west of San Francisco, are commonly reckoned at twelve in number, four of them ranging from 500 to 3,950 square miles in area, and the entire group amounting to 6,040 square miles. On examining a good chart of the Pacific Ocean, one finds a row of small islands and shoals having the same trend with, and being really a north-westerly extension of, the Hawaiian group. There are fourteen of these in addition to those usually styled the Sandwich Islands, twelve of which are claimed by the Hawaiians, while the two most remote belong to the United States, and are known as Midway and Ocean Islands. The U. S. government is said to have expended $100,000 in improving the harbor of Midway Island, and coal is stored here also for the benefit of our war vessels and Japanese steamers. It would appear that this harbor has not answered expectations, and consequently negotiations have been commenced with reference to the cession to the United States of certain privileges at the Pearl Harbor district near Honolulu.

Two diverse theories meet us in the attempt to explain the origin of this extensive chain, between the meridians of 154° 30′ and 180°, and 1,725 miles in length. They are cones rising from a submarine plateau 16,000 to 18,000 feet below the surface. One view is that they are of volcanic origin, commencing as submarine volcanoes, and built up of their own ejecta, even to the height of 14,000 feet above the sea-level. The smaller ones are atolls, and are usually encircled by coral reefs; so that, after their original volcanic start, they must have been submerged for the accumulation of the organic growth. The other view ascribes their origin to an enormous subsidence, the several islands being supposed to be the summits of mountains, the apices of an ancient continent, capped by coral growth. If these were once a continent, we understand why the flora should be so much diversified, since the plants would be driven to the uplands by the gradual subsidence. In the same way it is easy to see how the Hawaiians themselves might have made their way here from the East Indies. The Hawaiian government has established a genealogical bureau at an annual cost of $5,000, which devotes much attention to the early continental condition of the kingdom, as well as the study of the ancestors of the royal family.

Wallace accepts the former of these theories, and finds, from a study of the plants and animals, affinities with America, New Zealand, and Australia, the relation to the first being the most re-

mote. A botanist finds himself admiring the exaltation of our Compositae and lobelia into trees, and the violets, geraniums, and plantains into shrubs. The native phenogamous flora figures up to 554 species in Mann's catalogue, not including the grasses, and the ferns amount to nearly 150 species. Dr. Hillebrand, a former resident, has studied the plant-life most successfully, and has now in readiness for the press a complete description of all the Hawaiian plants. The government has declined to aid the publication of this volume, and it remains to be seen whether private enterprise will be adequate in bringing it before the public.

The most important scientific work done in the islands is of a topographical character, that of the government trigonometrical survey, under the very capable superintendence of Prof. W. D. Alexander. The annual appropriation has been $20,000 for many years. This survey was rendered necessary by the change from a feudal system of land-tenure to fee simple. In order to produce satisfactory results, the work must be like that carried on by the U. S. coast and geodetic survey. The boundary lines of the various tracts of land have now been drawn, and maps published of the islands of Oahu and Maui, and that of Lauai is ready for publication, while much labor has been expended upon Hawaii and elsewhere. The map of Maui, just published, is very creditable in every respect. The survey attends also to hydrography and to any special service required for particular purposes, as in the reconstruction of the large burnt district of Honolulu. The Hawaiians have two peculiar words to express the direction of boundaries, *mauka* and *makái* (upward and downward), those being the most natural terms to express geodetic positions in oceanic islands.

Prof. L. L. Van Slyke of Oahu college recently made an elaborate chemical examination of the various waters used for household purposes in Honolulu. The high north and south ridge of Oahu causes the vapors brought by the south-west trade wind to fall upon it and to flow upon the surface and in subterranean channels to the western leeward shore where the city is located. The amount of rainfall varies greatly, according to the locality. Near the ridge the annual precipitation amounts to 150 inches; in the upper part of Honolulu to 70 inches; and at the harbor as little as 30 inches. As the rock is volcanic, there is a predominance of sodium carbonate in the springs, and sodium chloride and lime carbonate in the deep-seated waters brought up artificially. Fresh-flowing water is obtained from the sea-level to the height of 42 feet through artesian boreholes, and this altitude corresponds to a recent elevation of coral rock, all around the island. There is not enough of the salt and lime compound to injure the water for potable purposes, but sufficient to indicate its marine origin. There are 25 of these flowing wells, the water reaching the same level in every one, and in the very dry season they fall off about three feet. Those yielding water are generally from 200 to 500 feet deep. The layers passed through are separate layers of clay, lava, and coral rock, and the water rises immediately after striking a black basalt at the base of the coral. The deepest well was put down at the edge of a tufa volcanic cone known as Diamond Head to the depth of 1500 feet. As fragments of coral abound in the tufa, it is probable that the volcanic action interfered with the regular downward flow of the rain-water, and this explains the absence of water.

The Hawaiian government is a limited monarchy. It was not until the beginning of the present century that Kamehameha the First brought all the islands under his sway, and founded the kingdom. About 1820 the chiefs rebelled against certain idolatrous observances, just before the arrival of the first deputation of American missionaries. Christianity was soon accepted by the higher classes, and then by the mass of the people; so that in less than half a century the country was regarded as Christian, and the foreign clergy withdrawn. They had in the mean while been instrumental in framing an excellent constitution, and either the missionaries or their descendants have held many of the important offices.

On the first of July there was a ministerial crisis in the kingdom and a new cabinet formed, with the same premier as before, but with new men in all the other offices. The cause of the disruption was partly personal and partly financial. Political parties divide somewhat according to sympathy or opposition to the missionary *régime*. King Kalekaua and his friends exalt the native Hawaiians, and desire to restore old heathenish customs, thereby seeking to awaken sentiments of patriotism. Their influence is against the best form of Christianity, and the men best qualified for their respective offices are dismissed when they sympathize with the missionaries. The king is also desirous of controlling the pastors of the native churches, tempting them to give up the voluntary system of support, and rely upon the government for their pay. The expenses of the government are one and a half millions of dollars annually, — a larger sum in proportion to the population than is raised by most of the states of our federal union. As this income is chiefly raised from the foreign residents, they are much dissatisfied with the government.

Meanwhile the native population is steadily decreasing. In 1823 there were 142,000, against 40,000 in 1884; and the foreigners, including the half-castes, are now as numerous, the sum total of the population being 80,578. The Chinese are the most numerous of the foreigners, amounting to about 18,000. Of the Caucasian element the Americans exceed all others in number. In fact, the islands are practically an American colony, and hence are entitled to such consideration from the U. S. government as is afforded by the reciprocity treaty. The decrease of the native population is due to bad influences introduced by foreigners. If it were possible to enforce rigorous laws relating to intemperance, licentiousness, and leprosy, and to train up the natives to engage in the most suitable occupations, the decrease might be stopped.

The most extensive business is that of raising sugar and selling the raw product to the California refineries. About eighty companies and firms are engaged in the business, and it is estimated that 90,000 tons, worth seven million dollars, will be shipped the present year. The best machinery and the latest improvements are employed in the manufacture of a superior grade. Most of the companies are controlled by Americans or persons of American descent, and the money hired to carry on the business is also American. Some prejudice has been felt against the business, because of the connection with it, in a very prominent way, of Mr. Claus Spreckels, an American citizen who has been very successful. He formerly controlled the sugar business of the islands, and was able to dictate his own prices to the planters. But the planters are now independent of him, as a new refinery has been started in California which actually buys and refines more sugar than Spreckles' establishment. It is fortunate for the Hawaiian government that this gentleman is so largely interested in the islands, as he is able to assist them by loaning funds, though, it must be confessed, with large interest. Perhaps for this reason he has recently reaped a golden harvest by carrying out the principles of the silver metallists. He had the contract for furnishing the government with a million dollars' worth of silver coin, according to the American standard, and realized from the transaction the difference in value between the silver and the gold.

It is unfortunate that the politicians stopped the investigations of Dr. Arning into the nature and possible cure of leprosy. He had instituted experiments with animals and condemned criminals, illustrating the propagation of the disease, and had discovered methods of ameliorating certain stages of the malady. Nothing could contribute more to the welfare of the Hawaiian kingdom than researchee of this character; and the removal of so efficient an experimenter for merely political reasons shows the prime cause of the decadence of the nation. What the government will be in the future, with its mixed population, no one can predict.

There is a social science club in Honolulu, meeting once a month, where questions of social, political, and physical science are vigorously discussed. The June assembly was held at the house of S. E. Bishop, whose name is familiar to the readers of *Science* as the discoverer of 'Bishop's rings' around the sun. Mr. Charles Cooke read a paper upon corporations, enumerating all the legal corporate bodies in the kingdom, followed by Chief Justice A. F. Judd upon the early history of the nation. The premier, Mr. Gibson, had said that the natives had done the most for the welfare of the nation, but Mr. Judd showed conclusively that the early missionaries had often saved the kingdom from destruction, especially when threatened by the irresponsible American, English, and French naval commanders. Had it not been for the prudence of Richards, the elder Judd, and other Americans, bombardment would certainly have followed the threats of those dissolute foreigners. The admirable constitution is due to the advice of the same missionary worthies. K.

Honolulu, July 4.

NOTES AND NEWS.

THE U. S. geological survey has partially mapped out its work for the present year. It will extend over a large portion of the United States. There will be nine parties at work in Virginia, West Virginia, Kentucky, Georgia, North Carolina, South Carolina, Alabama, and Tennessee. Prof. A. N. Thompson will have charge of two field-parties in Oregon, two in California, one in Arizona, three in Texas, and three in Montana. Professor Renshaw will have charge of three parties which will do work in Kansas and Missouri. Four parties working in Maryland, Massachusetts, and New Jersey, will be under the direction of Professor Baker. The chemical laboratory of the survey, which is located in the national museum, will continue during the summer months the examination of rocks, minerals, soils, and other matters necessary before the survey's work is published.

— The coast-survey work is still embarrassed, owing to the lack of funds to continue operations; and no further instructions have been given for field-work, pending the passage of the appropria-

tion bills. Mr. W. C. Hodgkins, who has been prosecuting the work of the survey on the North Carolina coast, near Cape Lookout, has returned to Washington, and is stationed at the office for the present. New editions of the charts of the north-west coast of America will be out within ten days.

— The total amount subscribed to date to sustain the Pasteur institute in France is $113,719. The sultan has presented Pasteur with the grand order of Medjidie, and $2,000, and will send a commission to Paris to study his methods of rabies prevention.

— Sixteen of the wolf-bitten Russians who were treated by Pasteur have reached Smolensk on their way home, and, being in perfect health, have telegraphed their gratitude to their preserver.

— Professor Ormond Stone has just issued part ii. of the first volume of the publications of the new Leander McCormick observatory. Part i., an account of the observations of the transit of Venus in December, 1882, was published in 1883. Part ii. is a small quarto pamphlet of seventeen pages, a series of notes on the tail of the great comet of 1882, accompanied by six plates of sketches made by the observers, Messrs. Leavenworth and Jones. These drawings will furnish useful material to those engaged in the interesting study of the theory of comets' tails, — a subject in which considerable interest has been aroused by the researches of Dr. Bredichin, director of the Moscow observatory.

— The Library bureau of Boston has issued the first number of a quarterly journal, *Library notes*, under the editorship of Prof. Melvil Dewey, librarian of Columbia college. While the journal is of especial value to the professional librarian, we should judge from an examination of the June number, and from what is promised for succeeding numbers, that it will also prove of considerable value to individual literary and scientific men who are interested in lightening the purely mechanical portion of their labors by the numerous ingenious devices which are constantly being brought forward. For instance, almost every scientific specialist nowadays finds it necessary to keep for himself a bibliography of some particular branch of his subject: he will find described in the number before us the size and quality of catalogue or index cards, with all the neat and convenient accessories which years of experiment or experience have pointed out to be best adapted to such purposes. The 'labor-saving notes' promise to be particularly useful to the lay readers, the aim being to bring to light, by co-operation and an interchange of ideas, the best literary tools and methods.

— The Spanish government has recently decided to establish a 'Maritime station for experimental zoölogy and botany,' to be in charge of a director, one assistant, and two fellows, all salaried. It is to be opened to students from all parts of the world, the results of all investigations to be published by the department of public works. In addition to the salaries of the officers, two thousand dollars annually will be appropriated for its support. The site has not yet been fixed upon, and *Cronica cientifica* justly complains of the inadequate provisions made for its establishment and support. Spain is almost the last of the chief civilized nations to found a zoölogical station.

— Roetheln, or German measles, has been very prevalent in Savannah, Ga., during the past year. This disease is very rare in the United States, and there are many physicians of established practice who have never seen a case. It prevailed in New York City during 1873 and 1874. As a rule children are attacked, but it is not exclusively the young; an old lady of seventy-seven was affected with it in the Savannah epidemic. It resembles both measles and scarlet-fever, so much so that the diagnosis is sometimes very difficult. It is contagious, and usually very mild, requiring but little treatment. Although it is doubtless a germ-disease, the specific microbe upon which it depends has never been identified.

— The legislature of Vermont at its last session passed a law prohibiting the adulteration of maple-sugar or honey, and punishing the offender with a fine of from twenty-five dollars to fifty dollars.

— M. Lessenne claims that a certain sign of death is the permanent gaping of a wound made in the skin by puncturing it with a needle. If the person be living, blood will usually follow the withdrawal of the needle, but whether it does or not, the wound will close at once. The puncture made in the skin of a dead person will remain open, as if made in leather.

— The North Carolina state board of agriculture, on Thursday, July 22, opened the new buildings of the experiment farm, near Raleigh.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Glaciers and glacialists.

In a note on glaciers in the Alps in the number of *Science* for June 25, p. 570, are the following words: "The longest is the Aletsch glacier in Austria, measuring over nine miles."

The Aletsch glacier is far distant from Austria, descending from the Jungfrau into the Valais, not far from the glacier of the Rhone. Its length is over nineteen miles.

The misstatements, errors, and false quotations, with regard to glaciers and glacialists are somewhat astounding, difficult to explain, and more so to excuse; for the whole matter belongs to our century, almost to our own time. It would seem, that with the advantages of the long teaching of Louis Agassiz, and the constant flow of travellers toward the Alps, a little accuracy and exactness might be in common use, and by this time all the facts ought to be classic. But it is not so; and lately the amount of false notions has been lamentably increasing. I will signalize a few of the latest and most glaring.

"Glaciers have become so well known from the graphic descriptions of Carpenter, Forbes, Agassiz, Tyndall, and others," etc. This first sentence of 'Existing glaciers of the United States,' by Israel C. Russell (fifth annual report U. S. geological survey, p. 399, Washington, 1885), will mislead any one not very well acquainted with the history of glaciers and glacialists.

Carpenter is an English name well known in science. W. L. Carpenter and W. B. Carpenter are both naturalists of renown, and it would seem that one of these two Carpenters is referred to. But it is not so: the *savant* mentioned under this wrong name is simply Jean de Charpentier of Bex (Switzerland), the celebrated author of the glacial theory for the transportation of the erratic bowlders. It requires a certain effort of imagination to recognize him under the name given by Mr. Russell.

If his list is intended as a chronological series, it is altogether wrong and unjust. Forbes was not the first after de Charpentier to investigate glaciers. Agassiz called Forbes's attention to the glaciers, at Glasgow in 1840, and introduced him to his Aar's glacier observations, at the 'Hôtel des Neuchatelois' in 1841, one year after Agassiz's publication of his important 'Etudes sur les glaciers.'

Prof. J. S. Newberry, in his address before the Cornell university, at the unveiling of the tablet to the memory of Louis Agassiz, June 17, 1885, says, "In 1815, Charpentier, the director of the salt-works at Bex, and one of the most distinguished geologists of Switzerland, passing a night in the cottage of a mountaineer in the hamlet of Lourtier, was told by his host that he believed that the glaciers had formerly a much greater extent than at present, because, as he said, 'I find huge bowlders of alpine granite perched on the sides of the valleys, where they could only have been left by ice.' This remark excited the interest of Charpentier, and was practically the beginning of the investigations which have resulted in the theory of the ice period. In 1834, Charpentier brought before the Association of Swiss naturalists at Lucerne a report upon the evidences of the former extension of the Swiss glaciers, the result of his observations through many years. At that time a group of young, able, and enthusiastic scientists were gathered at Neuchatel, — Agassiz, Guyot, Schimper, Desor, Carl Vogt, Wild, and others. The new theory of Charpentier, that ice had once filled all the Swiss valleys, excited in them the greatest interest," etc.

De Charpentier, in his 'Essai sur les glaciers,' etc., took special pains to say in regard to the mountaineer Perraudin of the Bagnes valley, at the foot of the St. Bernard, that his hypothesis was so extraordinary, and even so extravagant, that he did not think that it was worth looking into and thinking of: and he adds, "J'avais presque oublié cette conversation [showing plainly that it was not practically the beginning of the investigations], lorsqu'au printemps de 1829, M. Venetz vint me dire aussi que ses observations le portaient à croire que, non seulement la vallée d'Entremonts, mais que tout le Valais avait été jadis occupé par un glacier, qui s'était étendu jusqu'au Jure et qui avait été la cause du transport des débris erratiques" (*Essai sur les glaciers*, pp. 242 and 243).

The order of priority of discoveries is, first, Venetz, who in a memoir written and read in 1821 before the Swiss naturalists, and published in 1833 under the title of 'Mémoire sur les variations de la température dans les Alpes' (*Denksch. allgem. Schweiz. ges. gesam. naturw.*, Zurich), showed the greatest extension of glaciers and their gigantic thickness; second, Jean de Charpentier, who in 1834 read before the same Helvetic society of naturalists at Lucerne his memoir, 'Notice sur la cause probable du transport des blocs erratiques de la Suisse' (*Annales des mines*, 3e série, vol. viii. p. 219, Sept. et Oct., 1835; also *Bibl. univ. de Genève*, 2e série, vol. iv. p. 1, 1836; and translated into German by Julius Froebel, in *Mittheil. aus dem gebiete der theoret. erdkunde*, p. 482); and, third, Louis Agassiz, who first announced the existence of the 'glacial epoch,' or 'ice period,' in his 'Discours prononcé à l'ouverture des séances de la Société Helvètique des sciences naturelles, à Neuchatel, le 24 Juillet, 1837' (Actes de la Soc. Helv. des sc. natur., 22e session, Neuchatel, 1837; also *Bibl. univ. de Genève*, vol. xii. p. 367, 1837).

To Venetz is due the idea and proofs of gigantic glaciers, which transported the bowlders from the Alps of the Rhone valley to the Jura Mountains; to de Charpentier, the finding, accumulation, and the classification of material proofs (such as, the *moraines*, the *roches moutonnées, polies et striées;* the *cailloux striés* and *boue glaciaire*, etc.), which constitute the 'glacial doctrine;' finally, to Agassiz is due the 'ice period' and the prompt diffusion and acceptance of the theory of Venetz and de Charpentier.

Professor Newberry seems to think that in 1834, when Charpentier brought his theory forward at Lucerne, there "were gathered at Neuchatel, Agassiz, Guyot, Schimper, Desor, Carl Vogt, Wild, and others." It is a great mistake. Agassiz alone, of all those named, was then living at Neuchatel; Guyot did not come to live there until 1839; Schimper never lived there; Desor came at the end of 1837, Carl Vogt in 1839; and Wild was an inhabitant of Zürich.

Mrs. Agassiz, in her charmingly written history of her husband's life, says, "Agassiz was among those who received this hypothesis (the ancient extension of the alpine glaciers to the Jura) as improbable and untenable. Still, he was anxious to see the facts in place, and Charpentier was glad to be his guide" (*Louis Agassiz, his life and correspondence*, vol. i. p. 261, Cambridge). De Charpentier was a great deal more than his guide: he was his teacher; for Agassiz then knew almost nothing about glaciers, and certainly nothing about the glacial theory of Venetz and de Charpentier.

In the summer of 1836, Agassiz established himself at Sallaz, near 'des Dévens,' the residence of de Charpentier at Bex, to study under his direction.

De Charpentier studied with his friend Venetz the whole question, and created the glacial doctrine be-

tween 1829 and 1834. Being twenty years older than Agassiz, de Charpentier, then aged fifty-two, celebrated as one of the best observers in geology, conchology, and botany, was considered as the first naturalist then living in Switzerland. *Savants* from any part of the world, calling on him, received always a very amiable and generous hospitality. His beautiful and rich collections were open to all; and many who came there for only a passing call remained weeks and even months.

Agassiz had that magnetic power which attracted every one to him: de Charpentier was as well gifted, being the most charming and spiritual converser imaginable. Besides, de Charpentier was without ambition, a true 'scientific epicurean,' as he was called. Agassiz, with his power of quick perception, his excellent memory, his perspicacity and acuteness, his way of classifying, judging, and marshalling facts, quickly learned the whole mass of irresistible arguments collected patiently during seven years by de Charpentier and Venetz; and with that faculty of assimilation which he possessed in such a wonderful degree, and his insatiable appetite, he digested the whole doctrine of the glaciers. Then once in possession of that new and certainly very original and attractive tool, Agassiz, with his extraordinary imaginative power, saw that the phenomenon of the extension of old glaciers was not to be confined to the Rhone valley, but must be general, and was a special period in the history of the earth, during which cold prevailed all over the world. In a word, Agassiz, with his far-reaching thoughts, added an entirely unexpected and then generally very unwelcome step to the different periods which the earth has passed through,— the 'ice age.'

Every one knows with what rapidity the mere suggestion — some may call it the inspiration of genius — made by Agassiz, in his celebrated 'Discours d'ouverture' before the meeting of the Swiss naturalists at Neuchatel in 1837, became an accepted truth. Discovery after discovery came in rapid succession, — first in the Vosges in 1838; then in Scotland, England, Ireland, the Pyrenees, the Jura, Scandinavia, Finland, Russia, the Ural Mountains, Auvergne, Britanny, the Sierra Nevada of Spain, the Atlas in Morocco, Corsica, the Balkans, Lebanon and Syria, the Caucasus, the Himalaya, Altai, the Thian-Shan, the Kuen-Lun, the Kamtchatka, Japan, Alaska, British Columbia, Washington Territory, Oregon, California, the Rocky Mountains, all the eastern part of Canada and the United States as far as New Jersey and Kentucky, Central America, Colombia, Ecuador, Peru, Chili, the Straits of Magellan, New Zealand, and even very strong suspicions of the existence of ancient glaciers in Brazil, in Guinea (Gold Coast), and in Australia. What splendid record! and almost all during the lifetime of Agassiz; himself having the honor to establish the existence of ancient glaciers in Scotland and England, in the eastern part of the United States, in the Straits of Magellan, in Chili, and probably in Brazil.

But that is not all. Admitting that Agassiz has a little too quickly digested and assimilated the glacial theory of de Charpentier and Venetz, we can say now with no less truth that his powerful intervention has greatly advanced the time of the acceptance of that theory, by thirty years at least, and that besides his great discovery of the glacial epoch or ice age, which is unquestionably his own, Agassiz has done more to make known the glaciers than any one else; although he was not a physicist, and his explanations were faulty and inaccurate on many points.

These explanations and appreciations are rendered necessary by criticisms and strictures on the part taken by Agassiz, and even entire omission of his name: his successor at Harvard college having denied *in toto*, in a publication founded by Agassiz, — 'The memoirs of the Museum of comparative zoölogy,' — his great discovery of the 'ice age,' but having, more than that, ignored him altogether as the discoverer of the existence of ancient glaciers in the British Dominions, in New England and New York, in Brazil, in the Straits of Magellan, and in Chili.

On the other hand, some have gone too far in their eulogies. The part taken by Agassiz is grand and beautiful enough, without diminishing the great discoveries of Venetz and de Charpentier, both of whom were his teachers: for Agassiz was not alone in his visits at the house of 'des Dévens' in 1836; and all the explanations given by de Charpentier, and the excursions to the erratic bowlders, moraines, and glaciers, were made in company with several Swiss *savants*, — Venetz, Lardy, Mousson, Thomas, and Dr. H. Lebert. This last celebrated anatomist and naturalist has given his charming impression and souvenirs in his too short but excellent biography of Jean de Charpentier, read at Bex (Actes de la Soc. Helv. des sc. natur., Aug., 1877).

To be sure, Agassiz manifested his gratitude for the teaching of de Charpentier and Venetz in his 'Etudes sur les glaciers' (1840), dedicated on the first page, "A M. Venetz, ingénieur des ponts et chaussées au canton de Vaud, et à M. J. de Charpentier, directeur des mines de Bex." De Charpentier thanked him in his name and also in the name of Venetz, in the 'preface' of his 'Essai sur les glaciers' (October, 1840), a few days after Agassiz's work reached him at Bex. Notwithstanding this exchange of courtesies, an estrangement followed, due mainly to the interference of Agassiz's personal friends and collaborators; and after 1840 the friendship, or at least the relations, between de Charpentier and Agassiz, ceased entirely.

One more of the erroneous notices on glaciers and glacialists is in *Science* of April 30, 1886. At p. 389 we read, "Professor Dana's memoir gave an account of Guyot's early life which will be new to many of his American friends, and particularly called attention to the fact that Guyot had made a scientific examination of the Alpine glaciers two years before they were studied by Agassiz, and anticipated a number of his most important conclusions. In a paper read then before the Helvetic society, but never printed until 1883, Guyot pointed out that the upper portion of the glacier moves faster than the lower, that the middle moves faster than the sides," etc. It is difficult to imagine a more erroneous and unjust statement.

At Princeton Guyot was long isolated from intercourse with Swiss naturalists; and at the close of his life, while suffering under the malady which proved fatal in 1884, he put forth claims of doubtful value. These are the facts.

In 1838, Guyot, stimulated by Agassiz's constant conversation on the glaciers, passed five weeks among the glaciers of the Bernese Oberland and the Upper Valais. It was two years after Agassiz's study of the glaciers under de Charpentier, and one year after his

The climatic changes of later geological times. By J. D. Whitney. Cambridge, 1880-82. 4°.

discourse at Neuchatel, — a sufficient answer to the claims "that Guyot made a scientific examination of the Alpine glaciers two years before they were studied by Agassiz."

On the 5th of September, Agassiz and Guyot were present at the Réunion extraordinaire de la Société géologique de France à Porrentruy; and at the meeting of the 6th of September we read the following remarks: —

"M. Agassiz présente à la société ses *observations sur les glaciers*, d'où il déduit d'importantes conséquences géogéniques relativement aux *blocs* erratiques. . . . M. Guyot ajoute aux observations de M. Agassiz de nouvelles considérations" (*Bull. soc. geol*, vol. ix. p. 407).

That is all. Guyot did not read a manuscript, but offered only a few verbal observations. He was not then a member of the society; and his remarks passed off unnoticed, although geologists were present, well prepared to discuss any point relating to glaciers, — Agassiz, Jean de Charpentier, Bernard Studer, Thurmann, Max Braun, Lardy, Buckland, d'Omalius, Nicolet, and finally Renoir and Leblanc, who announced at that meeting their discoveries of old glaciers in the Vosges.

On the contrary, Agassiz's communication attracted much attention, and was the subject of many discussions and commentaries. Agassiz, strengthened and animated by the presence of de Charpentier, surpassed himself in his clear and trenchant exposition of the 'glacial theory.' The impression left on all those who were present at the Porrentruy meeting was such, that years after, several of them told me that Agassiz was absolutely irresistible, and won the admiration even of his strongest opponent there, Bernard Studer.

Neither Agassiz nor Guyot gave their notes to be printed; and it was almost one year later that Agassiz's memoir, 'Sur les glaciers,' was deposited at the 'secrétariat' of the Geological society at Paris. It was published at the end of volume ix. p. 413, as late as the spring of 1840. The same memoir appeared first in the *Bibliothèque univ. de Genève* (tome xx. p. 382) in December, 1839; and it was reprinted in 1844, at the head of 'Excursions et séjours dans les glaciers,' etc., by E. Desor.

Many years after the death of Agassiz, and one year after the death of Desor, Professor Guyot claimed that he wrote Agassiz's memoir, and added that he was unable to finish the writing of his own memoir by an '*indisposition qui dura jusque tard dans l'été* (1839).' Guyot returned to Neuchatel, however, in good health, in the fall of 1839; and, if his memoir remained *inédit*, it was because he did not think his maiden notice was of sufficient value for publication; for both the *Bulletin of the geological society* and the *Bibliothèque universelle* were open to him, and ready to accept his remarks.

James D. Forbes having claimed the discovery 'of ribboned structure' of the ice of glaciers, Agassiz took from Guyot's notes his remarks, "sur la structure lamellaire de la glace du glacier près du sommet du Gries," and published them in a pamphlet dated 11 April, 1842, Neuchatel. At the same time Agassiz begged Guyot to put his manuscript in the 'archives' of the Société des sciences naturelles de Neuchatel. This was done, and from that date the record of the existence of Guyot's notes is indisputable. Unhappily they were not published; and Guyot took them back in 1848, and carried them to America, whence, in April, 1883, he sent them again to Neuchatel, where they were finally printed in the *Bulletin Soc. sc. naturelles* (tome xiii. p. 156), the 26th of April, 1883.

It is impossible not to feel an uncertainty as to the primordial communication of Professor Guyot at Porrentruy, when we think of the delays in its publication, the travelling about, and the incompleteness of the notes. This feeling is increased by a remark of his widow, who says that Guyot did not send back to Neuchatel all the original manuscript, a part having been left in her hands (*The American journal of science*, May, 1886, p. 366).

But accepting the Neuchatel memoir of 1883 as correct, its scientific value is very small, and hardly justifies its publication. All that was truly of value was put in Agassiz's reply to Forbes; and even that is of small importance, considering that Rendu noticed more in detail the same phenomenon of veined structure of the ice, in his 'Théorie des glaciers de la Savoie,' published during the summer of 1840; and that Hugi, as far back as 1830, signalized the same phenomenon.

Accompanying his notes by a letter to M. Louis Coulon, president of the Neuchatel society, Professor Guyot claims that he has discovered not only '*la structure lamellaire de la glace des glaciers*,' but also the different modes of progression of the glaciers, the inclination of the beds at the end of glaciers, and the disposition of 'crevasses *en éventail*.'

These facts were known before, and were discussed almost daily in the house of de Charpentier, as is proved in the book of de Charpentier on the glaciers. Besides, Grüner, Hugi, Rendu, Bischof, and others have previously signalized the same facts.

Finally, Prof. Guyot, at the end of his letter to M. Coulon, makes statements entirely at variance with fact in regard to '*la distribution des blocs erratiques*.' For instance, he says, "The erratic map of the old glacier of the Rhone, published by de Charpentier (1840), stops it at Nyon, when by my latter observations I extended it far beyond Geneva to the Mont de Sion." Now, de Charpentier's map '*du terrain erratique de la vallée du Rhône*,' accompanying his celebrated book, does not stop the glacier of the Rhone at Nyon, but close to the city of Geneva, twenty miles farther south. As to bowlders of the Rhone valley as far as Mont de Sion, they have been described there by J. A. Deluc anterior to 1840; and R. Blanchet, in his 'Carte du glacier du Rhône' (Lausanne, 1844), extends the Rhone glacier as far as la Perte du Rhône, with a large moraine on the Mont de Sion.

From 1840 to 1847, Guyot, with great industry and perseverance, made a hypsometrical survey of the positions of the bowlders in seven of the erratic basins round the central Alps. Unhappily he only partially published his researches, in the *Bulletin des sc. nat. de Neuchatel*, without the map showing the distribution of those bowlders; reserving it, as he says, for an ulterior publication, in collaboration with Agassiz and Desor, which was never completed. If Guyot's map had been published then, it would have been an important contribution to the Alpine erratic phenomena. However, a great part of it — more than two-thirds at least — was anticipated by the issue in 1845, at Winterthur, of an anonymous map of the old glaciers of the central Alps, showing the extent of the ancient glaciers of the Arve, Rhone, Aar, Reuss, Linth, and Rhine, with their lateral and

frontal moraines. That map is entitled 'Verbreitungsweise der Alpen-fündlinge,' and its author is the modest and very able geologist, A. Escher von der Linth.

Since 1850, Gastaldi for Piemont, Chantre and Falsan for France, and A. Favre for Switzerland, have given maps of the ancient extension of the Alpine glaciers, which render Guyot's manuscript map obsolete and valueless, except as an historical document.

To finish this already too long review of glaciers and glacialists, I will add, that, after the three original memoirs of Venetz, de Charpentier, and Agassiz, of 1833, 1834, and 1837, the other important works and landmarks in the discoveries and exposition of the glacial question are, by order of data, 1°, 'Théorie des glaciers de la Savoie,' by the Chanoine Rendu (September, 1840); of this most important and excellent work, Tyndall said to me at the Geneva meeting of the Swiss naturalists in 1865, "If Rendu had been trained and educated as a physicist, he would have left nothing for others to do;" 2°, 'Etudes sur les glaciers,' by Louis Agassiz (October, 1840); 3°. 'Essai sur les glaciers,' by Jean de Charpentier (Oct. 31, 1840; issued in December, 1840, with the date on the titlepage of 1841); 4°. 'Travels through the Alps of Savoy,' by James D. Forbes (1843; second edition, 1845); 5°, 'Nouvelles études et expériences sur les glaciers actuels,' by Louis Agassiz (November, 1847); 6°. 'The glaciers of the Alps,' by John Tyndall (1860).

Venetz was personally known to but few *savants*. I will add that he was a Valaisan engineer of great skill. He had the charge of rectifying and embanking the Rhone in the cantons of Valais and Vaud, from Sion and Martigny to the lake of Geneva, — works which he executed most successfully. Accustomed to observe all that relates to the freshets of mountain torrents and glaciers, a spectator of the great 'débacle de Bagnes' in 1818, he and his friend de Charpentier put a stop to the constant ravages of the Getroz glacier and the Dranse River, an affluent of the Rhone.

Venetz's modesty was extreme, and verging on great timidity, due perhaps, in part, to the infirmity so common in the Valais, and from which he was a sufferer. Not educated as a scientific man, but only as a road engineer, he did not possess the scientific method of marshalling and classifying facts and observations. But Venetz found in his friend de Charpentier the best man to systematize and construct a new science. In that respect de Charpentier, by his knowledge and education, was the equal and rival of his friends Alex. de Humboldt, Leopold de Buch, and Elie de Beaumont; and the association of Venetz with him was most happy and successful. Both without ambition, lovers of nature and truth, they created together what may be called now one of the most interesting branches of geology and physical geography.

JULES MARCOU.

Cambridge, Mass., July 7.

Barometer exposure.

It is gratifying to find that my brief letter calling in question the influence of wind on the indications of indoor barometers has elicited very satisfactory responses from Messrs. Gilbert and Clayton (*Science*, vol. vii. pp. 571, 572; and vol. viii. p. 14). There is one point, however, on which evidence is still wanting to fortify Mr. Clayton's induction.

As clearly indicated by Mr. Gilbert, it is evident that, according to the conditions of exposure, the influence of the wind must tend sometimes to increase, and at other times to diminish, the pressure within the building in which the barometer is placed. Now, all of Mr. Clayton's experiments seem to indicate a lowering of the barometer-readings within the building. Perhaps he may be able to verify the deductions of theory by so arranging the conditions of exposure as to secure the opposite effect, and thus obtain a complete verification of his induction. If these opposite effects can be verified by experiment, while establishing the influence of wind as a true cause of barometric fluctuations, they would render it extremely difficult to apply a correction correlated with the velocity of the wind, except under well-defined conditions of exposure.

While seeking for possible causes of fluctuations of the barometric column in relation to wind-velocity, it may be well to recall the idea first broached by Hawksbee near the beginning of the last century, and more distinctly urged by Sir John Leslie, that the barometer is depressed by wind in consequence of the centrifugal force due to the horizontal current of air (Daniell's 'Elements of meteorology,' vol. i. pp. 4–9, London, 1845); for although Professor Daniell's criticism of Professor Leslie's theory is quite just, in so far as it relates to the idea that the effect would be 'accumulated by a long series of deflections,' yet the main fact, that the tendency to rectilinear motion would give rise to a centrifugal effect, remains a *vera causa* tending to depress the mercurial column.

A simple calculation shows, however, that the radius of curvature is so large, or the deflection from a tangent is so small, that a horizontal wind of 60 miles per hour, or 88 feet per second (assuming the whole thickness of the atmosphere to be involved), would lower the mercury in the barometric column only about 0.00875 of a millimetre, or 0.00034 of an inch, — an amount so small as to be far within the limits of observational error, and therefore quite inadequate as an explanation of the phenomenon.

JOHN LECONTE.

Berkeley, Cal., July 13.

Bright lines in the spectrum of β Lyrae.

A short study of the spectrum of β Lyrae presents the following bright lines as existing in her atmosphere. A portion are probably also found in the solar atmosphere. Referred to by their numbers in Young's catalogue, they are, 2, 3, 5, 22, 36, 41, 49 (58–59), 69, 74, 86, 100, (105–106), 115, (128–129), (140–141), 181, 189, 193, 198, 208, 248, (260–261), 267, (272–273?). Another portion find no place, or are infrequent, in the solar atmosphere, and, referred to by their approximate wave-lengths, are 59549, 58398, 57967, 57544, 56305, 55829, 54811, 51355, 51013, 50858, 50582, 49582, 47939, 47660, 47457, 46879, 45203, 43123.

Each of these appear in at least 40 per cent of the observations; none appear in more than 70 per cent. A number more are suspected, but are not clearly separated.

At present there would seem to be a connection between the variability of the star and the lines present in the spectrum; but on this point the observations are not final.

O. T. S.

New Haven, July 17.

Publications received at Editor's Office, July 12-17.

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Wisconsin academy of sciences, arts, and letters, transactions of the. Vol. vi. 1881-83. Madison, *State*, 1886. 356 p., 2 pl., illustr., map. 8°.

Advertised Books of Reference.

PHYSIOLOGICAL BOTANY: I. Outlines of the Histology of Phanogamous Plants; II. Vegetable Physiology. Goodale (Harvard), 8vo., 560 pp. $2.30. Ivison, Blakeman, Taylor & Co., Pubs., New York.

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INSTRUCTION FOR THE DETERMINATION OF ROCK-FORMING MINERALS. By Dr. Eugen Hussak, Privat Docent in the University of Grau. Translated from the German by Erastus G. Smith, Professor of Chemistry and Mineralogy, Beloit College. With 103 plates, 8vo, cloth. $3.00. John Wiley & Sons, Pubs., Astor Place, New York.

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ANNALS OF MATHEMATICS. Edited by Ormond Stone and William M. Thornton. Office of Publication: University of Virginia. $2 per vol. of 6 nos.

THE INTERNATIONAL CYCLOPEDIA. The best for popular use and specially adapted for ready reference. Fifteen royal 8vo volumes. 13,296 pages, 49,649 leading titles. Sold only by subscription. *Capable salesmen wanted.* Dodd, Mead & Co., Pubs., New York.

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SCRIBNER'S STATISTICAL ATLAS OF THE UNITED STATES: Showing by Graphic Methods their Present Condition, and their Political, Social, and Industrial Development, as Determined by the Reports of the Tenth Census, the Bureau of Statistics, the Commissioner of Education, State Officials, and other Authoritative Sources. 120 Pages Text, 151 plates (31 double), 279 Maps (22 folio). 969 Charts and Diagrams. Sold only by Subscription. Descriptive circular sent on application. Charles Scribner's Sons, Pubs., 743 and 745 Broadway, New York.

MANUAL OF THE BOTANY OF THE ROCKY MOUNTAINS. Coulter (Wabash Coll.), 8vo., 49 pp. $1.85. Ivison, Blakeman, Taylor & Co., Pubs., New York.

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STRUCTURAL BOTANY; or, Organography on the basis of Morphology; the principles of Taxonomy and Phytography and a Glossary of Botanical terms. Gray (Harvard), 8vo., 454 pp. $2.30. Ivison, Blakeman, Taylor & Co., Pubs. New York.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 23, 1886.

METHODS OF INVESTIGATION IN POLITICAL ECONOMY.

"DURING the last thirty years," says Sidgwick in his 'Principles of political economy,' "political economy has risen from the state of controversy on fundamental principles and method into that of an apparently established science, and again relapsed into the state of controversy." This statement is borne out by an examination of the literature of political economy during these years. It is full of controversy. Not only do writers fail to agree on practical economic questions, such as free trade and protection, mono- or bi-metallism, direct or indirect taxation, but they quarrel over the fundamental principles which are to be taken as the basis for the solution of these problems. We have the doctrine of *laissez-faire* on the one side, and of social expediency on the other. To some, economics is merely a science of wealth; to others, it is eminently social; and to still others, it is, in addition, ethical. Some stick to the principle of self-interest as the only one worth regarding; others take into account all the motives which influence economic action. Some seek for principles which shall be strictly true of an abstract 'economic man,' and then push all practical problems into an 'art' of political economy; while others desire principles that can be directly and usefully applied to existing human society, taking into consideration time, place, and circumstance.

It would be too much to say that this controversy over principles is at all ended. The conception of pure *laissez-faire* has, indeed, lost its position, and will probably never be reinstated; but the advocates of new and more liberal principles have not been able to agree among themselves. Some of them are nationalist, some socialist, some ethical; while they differ infinitely in the degree to which they still cling to the old ideas and the old formulae.

In regard to method as distinct from principles, on the other hand, we are beginning to see some light through the darkness. Men can acknowledge a change in method without giving up the validity of principles which they wish to maintain. Here the triumph of the new over the old has been complete; or rather there has been a vindication of the method of the master-minds over those disciples who by too close and dogmatic imitation had obscured the work of the fathers. Some of the keenest minds among students of political economy have worked at this topic; and owing to the efforts of such men as Knies, Wagner, Leslie, Jevons, and Ingram, we are reaching a substantial unanimity on the question of method.

How important this change is, and how fruitful of result it is going to be, will appear if we consider for a moment the difference between the old method and the new. Without going into the finer questions, and without being too exact in our definition, we may call the old method the deductive, and the new method the inductive. These terms will cover the other designations, such as '*a priori*,' 'abstract, 'philosophical,' sometimes applied to the old method; and similar terms, such as 'realistic,' 'historical,' and 'practical,' applied to the new.

The old method is essentially deductive. It finds certain premises which are true, and reasons from these premises to the solution of specific problems. These premises, as laid down by Cairnes, the most brilliant expounder of this view, and summarized by Cossa ('Guide to political economy,' p. 38), are as follows:—

"1. In the economic order of things the principal motive of human actions is *individual self-interest*. This induces man (*a*) to avoid pain (fatigue, work); (*b*) to desire pleasure (wealth); (*c*) hence to aim at obtaining the greatest amount of wealth with the least amount of labor, or, in more general terms, the greatest result with the least effort, which is, as it is now expressed, the law of least resistance.

"2. The earth, indispensable to man as a place in which to live and work, and as the source whence he may extract food and raw materials, is naturally limited (*a*) in the products which it contains; (*b*) in its actual extent; (*c*) in its relative fertility (different qualities of soil); (*d*) in its successive fertility (decreasing productiveness at a certain point with every new application of capital and labor).

"3. The physical and psychological tendencies of man lead him to multiply his own species with a rapidity which, if it met with no obstacles, would bring about an unlimited increase of population."

From these premises are deduced the three great theories of *value*, *rent*, and *population*; and by means of these theories concrete problems, such as free trade and protection, are solved.

It is not necessary here to describe how this deductive method of political economy has been overthrown. These assumed premises, although containing an element of truth, were in themselves incomplete and sometimes inapplicable. For instance, it is a matter of experience that men are actuated by other motives than self-interest, such

as patriotism, charity, and custom. Again, common sense revolted against the assumption that these theories were universal and perpetual; that is, true everywhere and at all times. Experience showed that at different epochs in civilization, and among differently situated nations at the present time, the premises would require very great modifications.

The new method in political economy is inductive; that is, it proceeds from observation of facts to general rules and principles. It carefully observes the limits of time and place, and abstains from asserting its principles to be either universal or perpetual. It makes use of what knowledge we have of man and nature; but it uses this knowledge for the purpose of guiding and helping its investigations, not as *a priori* premises. It studies history for the purpose of discovering what blunders men and nations have made in their economic experience, and how those blunders may be avoided in the future. The inductive method is also comparative; that is, it compares economic institutions performing the same function among different nations of the same degree of civilization, in order to discover which is the best. The method is, finally, statistical; that is, it collects statistical data as a basis for its knowledge, in order to measure economic forces and gauge the results of economic action. The present method of political economy as recognized by the greatest modern economists, such as Wagner, Schmoller, Leslie, Jevons, Marshall, etc., is historical, comparative, and statistical.

I do not propose to defend this new method against the old, much less to vindicate it. Neither do I deny that the old method has had able representatives, and that in its time it has done good service. All I assert is, that it is now practically abandoned as a method by itself, and that the future of political economy depends upon the scientific application of the new method to the complex phenomena of modern civilization.

It will be useful, however, to describe more fully how the new method is actually applied, what sort of results it is able to give us, and some of the advantages which flow from its use. I propose, therefore, to discuss, 1°, how to investigate particular economic problems; 2°, how to reach general principles of economic life; 3°, what are the collateral advantages of this method; and, 4°, how to make method and results useful in the study of other social sciences and in guiding state action in economic affairs.

How to investigate particular economic problems.

Every reader of John Stuart Mill will remember the opening paragraph of his 'Principles of political economy:' "In every department of human affairs, practice long precedes science; systematic inquiry into the modes of action of the powers of nature is the tardy product of a long course of efforts to use those powers for practical ends. The conception, accordingly, of political economy as a branch of science, is extremely modern; but the subject with which its inquiries are conversant has in all ages necessarily constituted one of the chief practical interests of mankind, and, in some, a most unduly engrossing one."

In the same way it might be said that the solution of economic problems precedes the formulation of an economic science. Mankind has always had its economic problems, and philosophic heads have ever busied themselves trying to solve them. The method of doing this is both of very great importance in itself, and indicative of the character of the science which will by and by be formulated on the basis of this method. It will be of interest, therefore, to show how the inductive method of political economy attacks practical economic problems, and to see what sort of a science results from this method. In choosing my illustrations, I have purposely selected modern economic questions, and American and English authors, in order to escape the common slur that this method is fitted only for the antiquarian, and used only by learned but unpractical and idealistic German professors.

Mr. Sidgwick has remarked, that, in that portion of political economy dealing with the production of wealth, the inductive and analytical method has been much more used than in those portions dealing with exchange and distribution. Take, for instance, the question of land-tenure,—one which has interested political economy for a long time, and which is to-day one of the burning political questions in England. It is apparent at a glance that the method of holding land must have a great influence on its productiveness. We can even reason *a priori* that where there is absolute proprietorship on the part of the cultivator, or at least a long leasehold which will secure to him the reward of his labor, he will be apt to work harder, and that the gross produce will thereby be increased. But the English economists, even Mill, Thornton, and Fawcett, have approached the subject in a different way. They have studied the condition of the French and Belgian peasants where absolute ownership exists, and have pointed out the prosperous condition of these countries as the proof that peasant proprietorship is the best system. This is the pure comparative method in political economy.

Let us take a more specific question. The issue

of bank-notes is a useful and at the same time dangerous function to intrust to a bank. Shall the issue of bank-notes be free, or shall it be regulated by government? How shall we answer such a question? If we examine the history of banking in the United States, as President Walker does in his book on money, or as Comptroller Knox did in his report for 1876, we shall find that freedom of issue has always been abused, and has always led to disaster, and that the only good bank money we have ever had in this country has been the national bank-notes secured by United States bonds. Study of the experience of England, Germany, and France will show that the liberty to issue bank-notes has everywhere been restricted, and is now exercised only by institutions under the direct or indirect control of the state. It can therefore be accepted as a rule that the privilege of issuing bank-notes should be carefully regulated by the state. This is the pure historical method in political economy.

Let us take a question which has not yet been solved, or where, at any rate, no practical solution has been reached by the legislature. Let us take, for example, the present silver question in the United States. Should the United States try to re-establish the silver dollar as a standard? There are two questions here. One is the question of the single or the double standard; the other is whether we can dispense with either one of the precious metals as money. The first, which is commonly known as bimetallism, although it is more properly the question of the single or the double standard, is already settled in the opinion of the best economists. One has only to read Professor Laughlin's book on the history of bimetallism to see that the double standard has been thoroughly tried in the United States from 1790 to 1873, and that it has signally failed. It always results in the presence of one metal and the absence of the other. At first, with a ratio of one to fifteen, we could keep no gold in the country: afterwards, with the ratio of one to sixteen, we could keep no silver. The history of France proves exactly the same thing, so that even professed bimetallists acknowledge that the double standard cannot be maintained except by international agreement. This, again, is the historical method.

The second part of the problem — viz., is there sufficient gold in the world to supply the demand for money, so that it is safe to demonetize silver? — is much more difficult to answer, and is, I venture to say, as yet unanswered. It can be solved only by the statistical method; viz., by showing that prices are declining, while at the same time the supply of gold is decreasing, and that the latter is the only adequate cause discoverable for the former phenomenon. As an example of an attempt to prove this connection, I may cite Mr. Giffen's well-known 'Essays in finance.' An even more noted example of the same style of applying the statistical method to economic problems may be found in the essay of Jevons, and also those of Cliffe Leslie on the effect of the gold discoveries in California and Australia on prices in Europe.

Finally, we may ask, what can the inductive method do when it faces some great economic problem which affects the whole community and civilization itself? Such a problem is the labor-problem. What is the condition of the laboring class? Has that condition deteriorated or improved? The inductive method has not shrunk from attempting to find an answer to even such questions as these. Thorold Rogers has laboriously traced the condition of the English laborer during the last six centuries, for the purpose of answering this question historically. Giffen has attempted, by statistics, to show that the condition of the laboring class has materially improved during the last fifty years.

These are examples of the historical, comparative, and statistical method applied to modern economic problems. In some cases the method has only confirmed what was known or at least surmised before; in most cases it has added directly to our knowledge; in a few cases it has given us results which could have been obtained in no other way. Such is the value of the method in these isolated cases. Can it be so utilized as to enable us to formulate a body of truth worthy to be called a science? This brings us to our second point, —

How to reach principles of economic life.

It is often said, that, although the inductive method may aid us in solving economic problems, it falls far short of what is required by a true science, because it does not enable us to formulate a body of principles which shall at the same time embody the highest truth, serve as a guide in future economic action, and be an explanation of all economic life. Nothing was more characteristic of the old school than the perfect confidence that they had the key to all knowledge on this subject. They were accustomed to speak of 'immutable laws' and 'eternal principles.' Self-interest, demand and supply, the law of diminishing returns from land, Malthus' law of population, Gresham's law, the wage-fund, equality of profits, — these were the touch-stones the application of which settled every problem. Is it a question whether strikes are able to raise wages?

According to the wage-fund theory, there can be no increase of wages except by increase of capital or diminution of the number of laborers; and as, according to the Malthusian theory, population tends to increase to the limits of food-supply, there will be no diminution of population, and hence no increase of wages is possible. Can any solution of the labor-problem be easier? Do we ask if a country should protect its home industries? Self-interest, it is said, leads each man to make the best bargain for himself, therefore free trade should be the universal rule. This answers the question for Germany as well as for the United States; for India as well as for England. Do we demand that the state control the charges of corporations? It is answered, profits tend to an equality in all employments: therefore, if in any one business profits are abnormally high, capital will rush into that business, and the charges will be brought down, and the public will be best served. Behold, the solution of the railroad question!

It is true that the new method does not give us principles which, like these (to use the expression of Ingram), are unchangeable, perpetual, and cosmopolitan. Neither does it lay down laws which can be applied by the rule of thumb to every new economic and social problem, wherever occurring, or under whatever circumstances. Such a science is, on the face of it, absurd. It is like introducing steam-engines where there is no fuel, or machinery where there is already an excess of hand-labor. It is like that pseudo-political science that desires to see representative institutions established in Egypt, or the trial by jury adopted by the Zulus. Such universal principles, like the *contrat social* and the theory of natural rights, have long gone by the board in social science. All we seek now are certain empirical generalizations which will guide our judgment in approaching practical problems. Such generalizations are not immutable laws; but they are extremely valuable to philosopher and statesman, just as the knowledge of markets and business methods is of value to a business man.

The statement, however, that the inductive method does not enable us to formulate any general principles of economic life is not true for two reasons: 1°. There is absolutely nothing in the new method to prevent our accepting and using any facts of the human mind or of nature which will aid us in determining how men act in economic affairs. No economist would venture on the solution of an economic problem without taking into consideration the fact that men are ordinarily moved by self-interest, any more than a general would manoeuvre for a battle without taking into account whether his men were fresh or tired, well fed or half starved, in good spirits or depressed. The economist is supposed to know what the leading characteristics of the human mind are, and to calculate their probable influence. The chief merit of the new school is that it studies carefully to give due weight to all of these forces, such as degree of civilization, custom, law, etc., which the older economists neglected. 2°. The new method has not the slightest objection to reaching general conclusions from its inductions, any more than the natural philosopher hesitates to reason from the fall of an apple to the law of gravitation. On the contrary, the very object of political economy according to this method, is to reach such general conclusions as will be of aid in directing social activity in economic affairs. From the experience of different nations in tenure of land, we reason to the general desirability of peasant proprietorship, or some fixity of tenure. From the history of the double standard, we reach Gresham's law, that, where two currencies exist side by side, the baser will drive the good out. From the history of English poor-laws, we can reason to the general desirability of self-help; and from the prosperity of England to the principle of free trade, at least for industrially developed nations. This is what Ingram calls reflective analysis, and is no more shut out from inductive political economy than it is from the natural sciences. To assert that the inductive method gives us merely sketches of economic history, or descriptions of economic institutions, or masses of economic statistics, is as wide of the mark as to call chemistry a mere collection of analyses of organic and inorganic substances. Science is systematized knowledge, and political economy seeks to systematize its knowledge gained through history, comparative study of institutions, and statistics, as rapidly as possible, so as to reach general principles of economic life. Only, by this method we escape the sterility which comes from following supposed immutable principles; for every fresh induction very probably modifies or corrects our previous rule. The principles we reach are, as said before, empirical at the best. Like the rising of the sun, they may be of a very high degree of certainty; or, like the predictions of meteorology, they may be of comparatively little value. We take them for what they are worth, and try by further observation to make them more exact.

The advantages of the inductive method.

It will strengthen our appreciation of the new method of political economy if we consider for a moment the collateral advantages which accompany it. In the first place, we acquire a great

mass of economic information. The mind of the student is soaked with knowledge of the past experience of mankind, with descriptions of present institutions, and with statistical details of economic life. No one can teach a class of students without being amazed at the eagerness with which they absorb the details of economic history, such as the finances of the civil war, or the silver legislation of the United States; or the interest with which they listen to the discussion of economic problems now in course of solution, like the Irish land question; or the curiosity with which they regard even statistical data of the movements of population and the course of trade. This is not to be wondered at. Every active intellect has a natural curiosity as to the history of the race and the institutions and customs of other nations. The inductive method satisfies this legitimate curiosity in a systematic and scientific way. Whether we are able or not to solve the particular problem which we have set before us, we at least get an intelligent knowledge of its difficulties. Whether or not we arrive at general principles, we gain information which in itself will be of value. This is a great advantage over the old method, which, when it was wrong, was altogether wrong and misleading. The new method is at least fruitful, and we get some result from our labor, even if we do not attain all that we sought for.

Again, the use of the inductive method tends to broaden our views of the relations of society. It familiarizes us with economic problems as they have come up in history, and shows us how they have been solved at different times and by different nations. It teaches us to view them from all sides, — in the light of past experience; in connection with the present state of civilization; from the stand-point of different nations, classes, and individuals. The new method is radical, inasmuch as it shows that economic arrangements are founded partly on the nature of things, but are also due in great part to the present state of civilization, and, to a certain extent, to accident and chance. It makes us ready to acquiesce in the possibility of changes in the future even in some institutions hitherto regarded as fundamental: in other words, it makes us believers in evolution and progress. But the new method is even more conservative: for it teaches us that social institutions and arrangements are the result of long growth and evolution; that they are intimately connected with civilization, and, when once established, are not to be lightly overthrown. History shows this: for it reveals how slow a growth real civilization is, and by what hard struggles we have attained to our present state. Comparison of institutions shows it: for it proves how universal are the human wants which the present institutions satisfy. Statistics shows it: for it discloses how complicated and delicate the social organization is, and the danger of laying violent hands on it. Socialists and revolutionists are generally men of one idea, followers of one-sided abstract theories. The true conservatism comes, as Burke long ago pointed out, from that reverence for the wonderful machinery of social organization which study by the inductive method gives.

Another advantage of the inductive method is that it prevents the science from degenerating into a mere collection of stereotyped formulae, and the practice of the science into the mechanical application of these formulae to the facts of human life. The danger which besets political economy in this respect has been abundantly illustrated above. Nothing in literature is sadder than the fatalistic pessimism which John Stuart Mill finds forced upon him after considering the possibility of an improvement in the condition of the laboring-class, on the basis of the wage-fund theory and the Malthusian law of population. Nothing was more destructive to the influence of political economy than the positive condemnation of factory laws and national education, which its teachers drew from the principle of self-interest and free competition. It is desirable, of course, to reach principles which are stable and always applicable; but we must not close the doors too soon against further evidence, and treat our science as a final revelation instead of a body of empirical laws gathered from the experience of mankind up to the present time, and with our present means of knowledge. It is true that the law of gravitation never changes; but the laws of political economy are not of that kind. As Bagehot has clearly shown, even the law of self-interest has absolutely no existence, or is entirely in abeyance in many communities and under certain circumstances. The laws of political economy are secondary laws, and it is not to be supposed that we have formulated them exactly and finally. It is as if a hundred years ago physicists had laid it down as an absolute immutable law that persons could not be transported faster than twelve miles an hour, because horses could not drag stage-coaches over turnpike roads at a greater speed. The old political economy is full of such mistaken assumptions that the generalization from a narrow range of experience is a highest principle. The inductive method teaches us at least modesty and caution.

A final advantage of the new method, closely connected with the one just mentioned, is that scientific truths are not so easily used for selfish

purposes when stated less absolutely. One great cause of the revolt against the old political economy was that it apparently taught the necessary misery of the greater part of the community. The socialists gladly seized on the 'iron' law of wages, and told the workingmen that either the political economy which taught it must be false, or that the civilization to which such political economy was applicable deserved only to be overthrown. A science which teaches that a great portion of mankind is destined to be miserable may not, for that reason, be unscientific; but it certainly ought to be very sure of its premises, and it cannot expect to be eagerly accepted. It may be a comfortable doctrine for capitalists, that strikes can, under no circumstances, permanently raise the rate of wages, and that factory-laws are destructive to the prosperity of industry; and they may utilize such doctrines to carry out their own selfish purposes. But it is a mistake to formulate scientific principles so absolutely that they can be used in this way. Under the old political economy, this was constantly being done. English factory-owners appealed to the principles of political economy against that legislation which is now universally admitted to be for the interests of the community. Free trade as much as protection has been the struggle of selfish interests. Even the skilful pen of Morley is not able to make of Richard Cobden any thing more than a 'Philistine' hero. We have at the present time editors of influential papers who see with ill-concealed satisfaction ignorant workingmen dash themselves against the stone wall of economic axioms. It is true, again, in physics, that, if you dash your head against a stone wall, you will get hurt. But the question is, Cannot the stone wall be removed? Is it necessarily and forever there? The absolute formulation of principles prevents even the asking such questions. It is for this reason that the inductive method appears much more reasonable. Political economy is neither a religious creed to be used to excommunicate all heretics, nor a legal code by which to condemn malefactors, but a body of experience to guide us in the conduct of social economic life. The inductive method forbids its being used for the private purposes of the priesthood or the judges, for new experience may teach us new solutions and new expedients.

Political economy and social science.

It has long been recognized that political economy is only one branch of social science, and it is an important question what its exact relation to the other branches of social science is. Social science as a whole may be defined as treating of human life in all its manifestations in society. It has numerous subdivisions (or, if you choose, you may say there are numerous social sciences), the principal of which are political science, jurisprudence, and political economy. The first treats of the governmental organization; the second, of the definition of rights and the conflict of wills; the third, of the satisfaction of material wants. The basis of the social organization is the economic; for man can reach no high development, either in state or law, until the material wants are satisfied. But the three sciences are intimately connected. The particular form of a state, nomadic chieftainship, monarchy, republic, etc., is commonly determined by the economic condition of the people; and law is often only the expression of such economic condition. Slavery is at the same time a political, a legal, and an economic institution. We cannot, therefore, cultivate political economy without at the same time cultivating the other branches of social science, especially political science and jurisprudence.

Such being the close connection between political economy and social science, it is an important question whether our method in political economy aids or hinders this correlation. The abstract method desires to put aside all this connection, and isolate the science of political economy. It expresses this desire in various ways. Commonly it formulates its theory as pure theory, and regards all other influences — political, legal, or social — as hinderances. The common analogy is taken from mechanics, the law of dynamics, which teaches that a body once set in motion will continue on in a straight line forever. But in practical life this is never realized, because there are always opposing forces, friction, etc. So the abstract 'economic man' would follow such and such a course of conduct, were it not for political, legal, and social influences. The artificiality of a scheme which treats the most powerful influences of human society — viz., those which hold men together in a state, and subject them to law, not to speak of family and social influences — as friction is at once evident. Another device is to say that there is a pure 'science' of political economy which treats only of the economic man, and that it belongs to the 'art' of political economy to consider these other influences. The trouble here, again, is, that, in the separation of the art from the science, the latter is almost sure to lose its vitality. Especially is it fatal when we try to connect political economy with politics and law, which have no sympathy with pure abstractions.

The inductive method avoids this artificial separation and distinction, this rupture between the theoretical and the real. It studies the facts

of economic life as they actually exist, blended with the political, legal, and social life. It has no such abstraction as the 'economic man,' but thinks only of man living in state relations, under the bond of law, and surrounded by the influences of family, custom, and social habits. Political economy is thus not isolated from the other branches of social science, but finds a thousand points of contact with them. It adds to their knowledge, and in return receives from them the explanation of many of its phenomena. In fact, we may say that each set of phenomena is inexplicable without some knowledge of the others, and to isolate them is to make each incomplete in itself.

The value of this method of investigation is strikingly seen in the function which political economy performs in the study of political science. That function is a double one. In the first place, political history can never be understood without a knowledge of the economic condition of the community which we are studying. The feudal system was possible only at a time when land was the principal kind of wealth. Aristocratic city republics could exist only where the growth of industry and commerce enabled the burghers to make themselves independent of the feudal nobility. Absolute monarchy rested on a class sufficiently rich to pay taxes, and sufficiently interested in the preservation of law and order to be willing to pay them. Representative institutions arose only when at last the industrial and commercial class was strong enough to assert itself against both kingship and land-holding aristocracy. The first function of political economy is purely historical. It investigates economic life in past ages for the purpose of explaining political history. When it gets down to the present time, it is purely descriptive, for the political institutions of different nations at the present time are conditioned by varying economic circumstances.

But political economy has a second function in connection with the study of political science. Every state action, every law that is passed, or ordinance enforced, or treaty negotiated, has economic consequences sometimes of the highest importance. Political economy must here direct state action, must say what will be the consequences of such action, and whether it will be for good or evil. It can do this only by appeal to history, by comparison of the experience of other nations, and by the use of statistics. In other words, we find that the most faithful ally of political science is the use of the historical, comparative, and statistical method of investigation in political economy.

RICHMOND MAYO SMITH.

RECENT BOOKS ON PSYCHOLOGY.

WHEN a very successful English translation was made some years ago of Ribot's 'La psychologie Anglaise contemporaine,' it was a matter of surprise that his 'Psychologie Allemande' also was not translated as soon as it appeared. For though we may agree with Mr. James Ward, that the latter book is in a measure superficial and sometimes misleading, it is nevertheless the only compact summary of that psychological activity in Germany that began with Herbart; and that is that represented to-day by Professor Wundt of Leipzig. We are very glad that it is now put into the hands of English readers. M. Ribot has found that the advance in psychological investigation between 1879 and 1885 has necessitated the rewriting of his original work; and it is from this second French edition that the translation before us is made.[1]

This second edition is without the brief but interesting chapter on Beneke which was included in the first edition, but as compensation it covers the latest discussion of Weber's law and the more recent investigations of Wundt. Ribot is very clear as to what he means by the German psychology of to-day: he calls it the 'new' psychology, but rather exults than otherwise in the idea of 'a psychology without a soul.' He describes the new psychology tersely, thus: "It has for its object nervous phenomena accompanied by consciousness, finding in man the type most easy of recognition, but bound to pursue the investigation through the whole animal series, however difficult" (p. 8). This is explicit enough surely, but has a strange sound to the student of English psychology, who is accustomed to the discussion of problems which the Germans, since Kant, have relegated to a separate branch of mental science called *erkenntnisstheorie*.

For the older school of psychologists, M. Ribot expresses what we may best designate as respectful contempt. "We owe to it good descriptions, excellent analyses; but its work is done. Its province now is simply details, shades of meaning, refinements, subtilties" (p. 3). This is, in its way, exquisite, and is one of the many passages in which M. Ribot implies that Locke, Leibnitz, Berkeley, Hume, Reid, Stewart, and Hamilton can be called psychologists only by historical courtesy. With this narrow conception of psychology we are not going to quarrel: we merely point it out as the key to understanding M. Ribot's excellent accounts of Herbart, Lotze, Fechner, and Wundt. Nowhere else are their investigations and teach-

[1] *German psychology of to-day: the empirical school.* By TH. RIBOT. Tr. by T. M. Baldwin, B. A., with a preface by James McCosh, D.D., LL.D., Lit. D. New York, *Scribner*, 1886. 8°.

ings brought together so clearly and so compactly as in this little book. It should be in the hands of every student of psychology, and most of it will appeal even to readers who are without special philosophical training. Of the translation we can speak cordially, but not enthusiastically. It is clear and accurate enough for all practical purposes, though more attention to literary form would have improved it. The unpardonable lack of any index to such a book as this should be remedied without fail, if a second edition is ever called for.

Dr. McCosh's new book [1] would undoubtedly incur M. Ribot's condemnation; for while recognizing the work of the new school in investigating the relations of mind and brain, in measuring the duration of psychic acts, etc., it views psychology from the old-school stand-point. It is refreshing to read a book so clear, so candid, and so self-confident; and, even when disagreeing with the positions of the author most completely, we cannot withhold our admiration from his vigor of thought and expression. This book is the final expression of President McCosh's well-known psychological views. It is based on his academic lectures, and is a direct, simple, and dogmatic presentation of his system. Dr. McCosh does not beat around the bush. He defines the soul as "that self of which every one is conscious" (p. 1); self-consciousness, as "the power by which we take cognizance of self as acting; say, as thinking or feeling, as remembering the past or anticipating the future, as loving, fearing, and resolving" (p. 2). We have intuitive evidence of the existence of the soul (p. 7). "It is not the exact or full truth to say that I feel an external object, or that I have an idea of it (which I may have when it is not present), or that I apprehend it, or have a notion of it, or believe in it: the correct expression is, that I have knowledge of it, or that I cognize it" (p. 20). These are Dr. McCosh's postulates, and on them his system is built up. We believe that it is coherent, but that it is not scientific. Its fundamentals are assumed, not proven. It is a system that will not allow the question, 'How is knowledge possible?' to be raised. It follows Reid and Hamilton in assuming the famous distinction of primary and secondary qualities without meeting the arguments of Berkeley, Kant, and Spencer. Yet we fully admit that it is far easier to find fault with Dr. McCosh's system as a whole than to replace it. Perhaps the time has not yet come for building a complete system of psychology on the new basis.

In this book Dr. McCosh deals only with the cognitive powers, reserving his treatment of the motive powers for another volume. This we hope will be issued before long, and enable us to view entire the venerable author's psychological teaching. When the history of philosophy in America comes to be written, it will be found, that, right or wrong himself, no one has contributed so much, or given such an impulse, to the study of philosophy and psychology in this country, as the distinguished president of Princeton.

Of Mr. Jones's 'Human psychology' [1] we need not say much. It is principally a compend of other persons' views in other persons' words. It is not unskilfully put together, but cannot expect recognition as an original or independent treatise. It is of no use to the trained philosophical teacher, and a poor manual to recommend to an untrained student.

[1] *Psychology: the cognitive powers.* By James McCosh, D.D., LL.D., Litt.D., New York, *Scribner*, 1886. 12°.

[1] *Human psychology: an introduction to philosophy.* By E. Jones, A. M. New York, *Baker & Taylor.*

Mr. Graber has recently described, in the Transactions of the Vienna academy, the results of observations indicating that eyeless animals are sensible to light. In a box divided into compartments, and each furnished with two openings, he distributed equally a number of earth-worms. One of the openings in each compartment he obscured or concealed, and exposed the box to the light, examining the worms from time to time, and adding new ones every four hours. By repeated observations he found that they showed a decided tendency to withdraw to the darker parts of the compartments, only forty out of a total of two hundred and fifty remaining in the light. He also studied the influence of different rays upon them, and found them susceptible to the different colors. When the openings were covered with blue and red glass, they manifested a marked preference for the red light.

— Mr. A. Sanson, in an article in a recent number of the *Revue scientifique*, states, that, from a comparison of animal and steam power, in France at least, the former is the cheaper motor. In the conversion of chemical to mechanical energy, ninety per cent is lost in the machine, against sixty-eight in the animal. He finds that the steam horse-power, contrary to what is generally believed, is often materially exceeded by the horse. The cost of traction on the Montparnasse-Bastille line of railway he found to be for each car, daily, fifty-seven francs, while the same work done by the horse cost only forty-seven francs; and he believes, that, for moderate powers, the conversion of chemical into mechanical energy is more economically effected through animals than through steam-engines.

Fig. 1. — Forty-nine members of the last senior class.

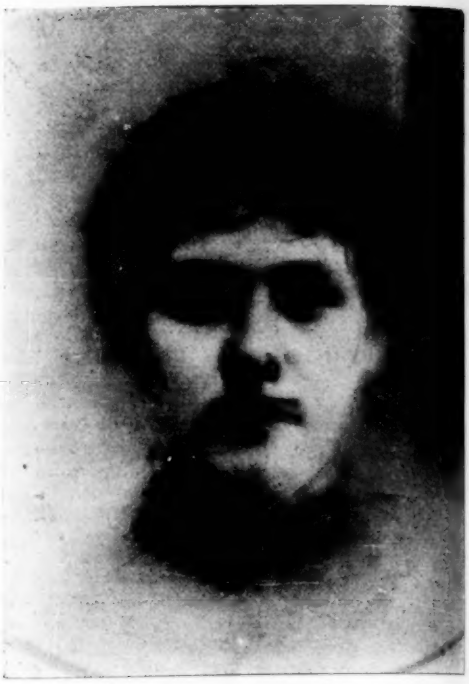

Fig. 2. — The same as fig. 1, but adjusted for the eyes.

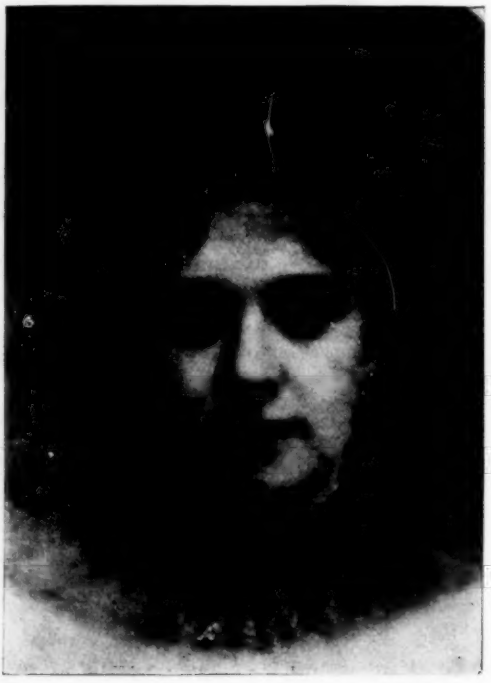

Fig. 3. — Ten members of the same class, forming division in physics.

Fig. 4. — Twenty members of the last senior class.

COMPOSITE PORTRAITS OF SOME SMITH COLLEGE STUDENTS.